July 1996 Highlights of the Pulsed Power Inertial Confinement Fusion Program

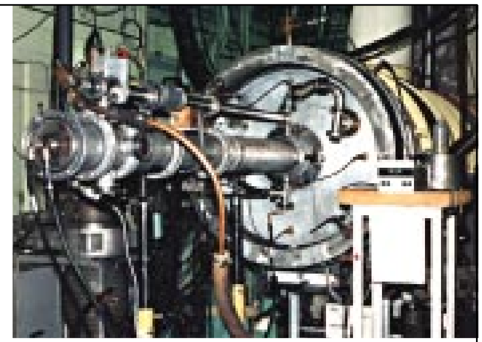
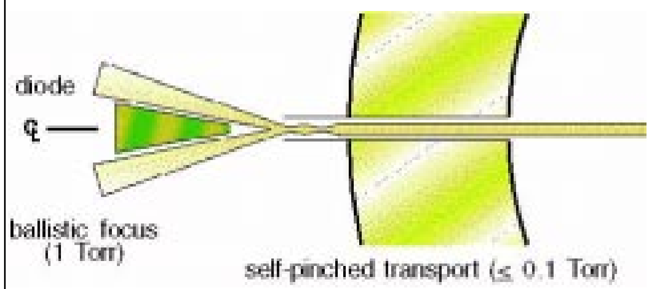


Fig. 1. Photo of Gamble-II generator at NRL in ion transport mode.
Fig. 2. Schematic for self-pinched transport in shallow-focusing,



Results from the first shots with the shallow-focusing, shaped anode on the new Gamble-II extraction ion diode were obtained at NRL. We are developing plans for imploding hohlraum experiments driven by z pinches on PBFA Z. We met with Sandia personnel from the Ion Micro-Analysis Group and with contractors from W. J. Schafer Associates to discuss fabricating and characterizing foam cylinders for these imploding hohlraum experiments.

The new extraction ion diode on Gamble II (Fig. 1) at NRL is being tested at 1.2 MV. The 2-D magnetic field code DATHETA was used to determine the anode shape. The diode will generate and focus protons for self-pinched transport experiments. Self-pinched transport should relax requirements on ion beam divergence by a factor of two. At half the predicted focal length of the diode (36 cm from the anode) the beam, injected through a foil into 1-Torr air, is recorded on a witness plate and imaged through multiple pinholes onto radiochromic film. Preliminary analysis suggests that, when the anode-cathode gap is insulated by the applied magnetic field, the beam focusing is similar to DATHETA predictions. Variations in beam current density as a function of radius are controlled by adjusting the magnetic field shape. As expected, some spin on the beam is seen in the absence of a counterbalancing magnetic field pulse. With proper application of this counterpulse, however, ions born on the separatrix will have zero canonical angular momentum and a maximum amount of beam will focus on axis. Simulations with the 3-D, electromagnetic, hybrid (mixed fluid and particle) code IPROP have been done that will guide self-pinched transport experiments (Fig. 2) at 1.5 MV after optimization of beam focusing is completed.

We are reviewing the characterization and fabrication needs for low density foams in imploding hohlraum experiments on PBFA Z and Saturn. The Ion Micro-Analysis Group (IMAG) at Sandia uses focused MeV ion beams to identify, with micron-scale resolution, defects in low-density foams. IMAG has measured the density uniformity of aerogel and agar foam targets made at Sandia. These targets, with an overcoat of a conductive material, were used in the initial imploding hohlraum experiments with z pinches on Saturn in May. Discussions with W. J. Schafer personnel included composition, density, machinability, durability, and handling requirements of the foam cylinders and cylindrical shells. Low density (~ 5 mg/cc) CH_2-based foam or high density (~ 25 mg/cc) polystyrene foams can be provided.

We are developing program plans for the usage of PBFA Z to study high energy density physics (HEDP) issues after completion of modifications to allow z-pinch-driven implosions. These HEDP issues include energy and power optimization on PBFA Z, hohlraum characterization and optimization, and capsule physics (radiation flow, ablator physics, and hydrodynamic instabilities). The required diagnostics and hardware changes are being determined for target experiments on PBFA Z. The “commissioning” phase of PBFA Z will last until next summer. After that time, experiments by outside users will be encouraged. A suite of diagnostics that includes x-ray diodes, transmission grating and crystal spectrometers, pinhole cameras, and active shock breakout will be provided for both internal and external users. New diagnostics to be added to PBFA Z include an x-ray backlighter and neutron time of flight.

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